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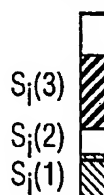
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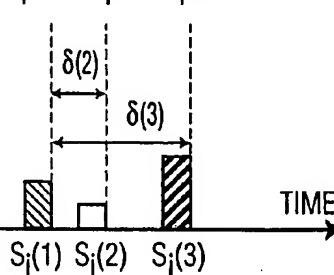
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- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: **METHOD AND DEVICE FOR ROBUST REAL-TIME ESTIMATION OF BOTTLENECK BANDWIDTH**

BURST  $i$ TH CONSISTING  
OF 3 PACKETS



$t_i(1)$   $t_i(2)$   $t_i(3)$



TIME

IMPULSE FUNCTION ON  
INPUT: SEVERAL PACKETS  
BACK-TO-BACK

IMPULSE RESPONSE ON  
OUTPUT: THE SAME PACKETS  
ARE NOW SPREAD OUT

(57) Abstract: A method and device for estimating the bottleneck bandwidth over a communication network is provided. The method includes the steps of: transmission by the sever through a bottleneck link a plurality of bursts comprised of packets to the client; calculating a set of bandwidth samples for each burst received by the client end; determining a new bottleneck bandwidth from the calculated bandwidth samples for the following transmission of data packets between the server and the client. The device capable of estimating a bottleneck bandwidth includes: a means for transmitting a plurality of bursts comprised of packets; a means for receiving each burst packets via a bottleneck link; a means for generating a set of bandwidth samples based on a difference between an inter-packet spacing between the first and the last packet within each burst; and, a means for determining the current bottleneck bandwidth from the generated bandwidth samples.

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## INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 02/01435

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04L12/26 H04L12/56

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, IBM-TDB, INSPEC, COMPENDEX

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SISALEM D; SCHULZRINNE H: "The Loss-Delay Adjustment Algorithm: A TCP-friendly Adaptation Scheme" NETWORK AND OPERATING SYSTEM SUPPORT FOR DIGITAL AUDIO AND VIDEO (NOSSDAV), [Online] 8 - 10 July 1998, XP002226884 Cambridge (UK) Retrieved from the Internet: <URL:http://www.cs.columbia.edu/~hgs/papers/Sisa9807_Loss.pdf> [retrieved on 2003-01-10] page 6, line 3 - line 30	1,2,6
A	-----	3,4

☐ Further documents are listed in the continuation of box C.☐ Patent family members are listed in annex.

## \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&amp;" document member of the same patent family

Date of the actual completion of the international search

17 January 2003

Date of mailing of the international search report

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Name and mailing address of the ISA

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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/IB 02/01435

## Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this International application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-4, 6

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-4,6

A method for estimating a bottleneck bandwidth rejecting bandwidth samples encountering an operating system delay of the client system.

2. Claim : 5

A method for estimating a bottleneck bandwidth rejecting bandwidth samples having a retransmitted packet.

3. Claim : 7

A method for estimating a bottleneck bandwidth for a low speed link.

4. Claim : 8

A method for estimating a bottleneck bandwidth for a high speed link.

5. Claim : 9

A method for estimating a bottleneck bandwidth in a multi-channel link.

6. Claim : 10

A method for estimating a bottleneck bandwidth which eliminates bandwidth samples having missing packets.

7. Claims: 11-23

A method and a device for estimating a bottleneck bandwidth wherein said bandwidth samples are computed based on a difference between an inter-packet spacing between the first and the last packet within each burst.